

AMENDMENT TO SPECIFICATION

Please add the attached "New Sheet" of drawings to the specification, as requested by the Examiner.

Please add the following paragraph after paragraph [0007]:

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a schematic representation of a system of printing durable ink-jet ink images in accordance with an embodiment of the present invention.

Please add the following paragraph after paragraph [0052]:

In accordance with an exemplary embodiment, FIG. 1 depicts a schematic representation of a system 2 for printing durable ink-jet ink images in accordance with an embodiment of the present invention. The system includes ink-jet architecture 4, 6, which can contain one or more colored ink-jet inks 14 and/or a fixer composition 16 as described above. In this system, offset media 10 is used as the printing media. Once the image is printed on the offset media, pressure can be applied to the printed image, which pressure can be applied using a calendering device, such as a pair of rollers 22.

Please amend the specification as follows:

Abstract

The present invention is draw to the use of post calendaering of ink-jet produced images on offset media to improve smudge resistance and image quality. More specifically, a system for printing durable ink-jet ink images can comprise offset media; an ink-jet ink; and a calendaering device. The ink-jet ink can include a pigment colorant, and can be configured to be printed on the offset media. The calendaering device can be configured for applying pressure to offset media once the ink-jet ink is printed thereon. A method is also provide that comprises steps of ink-jetting an ink-jet ink onto offset media to form a printed image, wherein the ink-jet ink includes a pigment colorant; and applying pressure to the printed image such that a physical property of the printed image is altered by the pressure.

[0005] It has been recognized that it would be advantageous to provide systems and methods for ink-jet printing on commercial offset media, while obtaining both good smudge/smear resistance as well as good image gloss. As such, a system for printing durable ink-jet ink images can include offset media, an ink-jet ink, and a calendaring device. The ink-jet ink can include a pigment colorant, and can be configured to be printed onto the offset media. Further, the calendaring device can be configured to apply pressure to the offset media once the ink-jet ink is printed thereon.

[0018] As used herein, "bleed" refers to the tendency of ink to run into and mix with adjacently printed inks. Bleed typically occurs prior to adjacently printed inks fully drying on a substrate. The degree of bleed will depend on a variety of factors such as the drying speed of the ink, ink chemistry, i.e. the presence of reactive or non-reactive bleed control mechanisms, and type of substrate, among other variables. For example, as offset media typically does not allow for rapid penetration of typical ink-jet inks, optionally, a fixer composition can be used to prevent bleed and/or coalescence prior to post calendaring. Similarly, the term "feathering" refers to rough edges that occur at the interface between a printed image and an unprinted portion of the substrate. Both of these characteristics are typically undesirable.

[0022] Due to the relative nonporous and hydrophobic nature of coated offset media and offset ink, more conventional water-based ink-jet inks are not typically durable, and exhibit bleed and coalescence when printed thereon. It has been recognized that these problems can be overcome by using pigmented inks, and optionally, underprinting or overprinting the ink-jet ink with a fixer composition. However, particularly with respect to printed images that utilize fixer composition with a pigmented ink-jet ink, reaction between the ink-jet ink and the fixer composition can destroy gloss inherently present in the offset media. Thus, it has further been recognized that utilizing a post calendaring process after printing such an image can be used to regain image gloss loss and/or improve durability, as is desirable in some applications.

[0023] Thus, in accordance with embodiments of the present invention, a system for printing durable ink-jet ink images can include offset media, an ink-jet ink, and a

calendaring device. The ink-jet ink can include a pigment colorant, and can be configured to be ink-jet printed onto the offset media. Further, the calendaring device can be configured for applying pressure to the offset media once the ink-jet ink is printed thereon.

[0025] With respect to both the system and method described herein, other optional components or steps, respectively, can be present. For example, a fluid-jet pen containing a fixer composition can be present in the system, and the fluid-jet pen or another similar device can be used for underprinting or overprinting fixer composition with respect to the ink-jet ink prior to calendaring. In another embodiment, latex particulates can be dispersed in the ink-jet ink, and/or in an overcoating composition to be applied after application of fixer and/or ink. In either case, whether present in the ink-jet ink or the overcoating composition, the latex particulates can be present at from 0.1 wt % to 15 wt %. In a more detailed aspect, the latex particulates can be present at from 1 wt % to 5 wt %. Other variations can also be present as well.

[0049] Post Calendaring

[0050] After printing on the offset media with the pigment-containing ink-jet ink (which can optionally be underprinted or overprinted with a fixer composition as described), a post calendaring process can be carried out to accomplish one or more desired results. For example, the application of pressure to printed image can physically alter the printed image by leveling and/or smoothing the printed image. In one embodiment, mechanical pressure, such as by smooth rollers, can be applied to the printed image causing it to change from a more textured state to a more smooth state. The pressure can cause ink-jet ink printed image to flow. In one embodiment, the pressure applied can be applied at from 500 psi to 3000 psi. Though this range is provided as a guideline, depending on the material used, various amounts of pressure/temperature can be applied.

[0052] With respect to selecting the amount of pressure, and optionally heat, to apply, one can consider that the application of too little pressure can be ineffective for providing gloss and smudge resistance, and if elevated temperature is used, the

application of too much temperature can cause the image to transfer to the rollers. Other variations of the application of pressure and heat can also be carried out in accordance with embodiments of the present invention. For example, other devices other than rollers can be used to apply the pressure, such as a flat press that can apply direct pressure to the printed image. Alternatively, textures can be applied to the ink-jet ink during the post calendaring process. If more smooth rollers are used, then gloss can be regained throughout the printed image. However, if embossing rollers are used, then gloss may be returned to the printed image in areas corresponding to where a roller exerts pressure to the image, e.g., raised areas of the roller(s).

[0059] The fixer composition of Table 1 was printed onto Lustro Laser offset media in multiple bar patterns. The ink-jet ink of Table 3 was then printed on top of the various bar patterns, followed by the overcoat composition of Table 4. Some of the printed samples were calendared in accordance with embodiments of the present invention, and the remaining samples were not calendared. The calendaring process was carried out by applying 1750 psi of pressure and 52.degree. C. of heat to the printed offset media using a pair of metal rollers at a rate of 37 feet/min. Once the samples were prepared, a yellow alkaline highlighter pen was passed across each of the samples a number of times. Upon smearing, the test was stopped. The printed images that did not undergo a calendaring process began to smear after only four passes of the alkaline pen. The printed images that were calendared did not begin to smear until eight passes of the alkaline pen.

[0060] The fixer composition of Table 1 was printed onto Lustro Laser offset media in multiple bar patterns. The ink-jet ink of Table 2 was then printed on top of the various bar patterns, followed by the overcoat composition of Table 4. Some of the printed samples were calendared in accordance with embodiments of the present invention, and other samples were not calendared. The calendaring process was carried out by applying 1750 psi of pressure and 52.degree. C. of heat to the printed offset media using a pair of metal rollers at a rate of 37 feet/min.

[0061] The effect of calendaring on gloss was determined by considering the 60

degree gloss of various colors printed. The results are provided in Table 5 below:

Table 5 – Effect of calendaring on gloss

Printed Color	60 degree gloss (before calendaring)	60 degree gloss (after calendaring)
White	37	44
Black	15	42
Cyan	15	39
Magenta	18	47
Yellow	19	52
Red	18	46
Green	18	46
Blue	14	37
Orange	22	52
Purple	23	46
Light Black	36	56
Light Cyan	41	55
Light Magenta	42	56
Light Yellow	41	58
Light Red	32	56
Light Green	28	53
Light Blue	26	50

[0062] As can be seen by Table 5, in every case, post calendaring of printed images improved gloss. As Lustro Laser offset media is a glossy paper, the gloss of the image upon post calendaring can be more closely matched to the offset media, thereby improving image quality.